

Application No.: 10/661,221

Amendment and Response to Office Action dated May 24, 2006

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**REMARKS**

Claims 1 and 3-34 are in this Application and are presented for reconsideration. By this Amendment, Applicants have amended the claims 1, 3, 19, 21, 22, 24, and 29 to clarify the important combination of features which define over the prior art of record, canceled claim 2, and added new claims 30-34.

The Examiner did not enter the previously filed amendment dated August 23, 2006, because he deemed the additional features did not place the application in a better form for appeal. Thus, Applicants emphasize, herewith, additional aspect of the present invention by this Amendment, which places the application in a better form for appeal. The independent claims 1, 19, 24, and 29 have been amended and dependent claim 2 has been canceled to reflect this emphasis.

In addition, in his Office Action dated May 24, 2006, the Examiner pointed out that the previously added claim language of a system that is in-line and downstream of "hydrocarbon or chemical-processing equipment" does not contain any features directed to "oil refining equipment" or "chemical refining equipment." Applicants note that the feature of "hydrocarbon or chemical processing equipment" was added in the Amendment dated April 18, 2006, because Examiner suggested in his Office Action dated November 22, 2005, that the "chemical processing equipment" was not positively recited (Page 2, Line21). Regardless, Applicants have also taken heed of Examiner's suggestion and added the feature of "chemical refining equipment" in the independent claim 19.

The new claims 30 and 31 emphasize the pH levels for getting optimized results. This had been disclosed in the original charts, and is not a new matter.

The new claims 32 and 33 disclose the process condensate and caustic feed features of the present invention. This has been disclosed in the original disclosure (paragraph [0010] and [0034] respectively) and does not add any new matter to the application.

The new claim 34 as well as dependent claim 22 present the previously submitted feature of contaminants such as ammonia being directed to rejects. This is extensively discussed in different places in the disclosure, especially in paragraph [0034] and shown in the tables as well. This is also not a new matter. These claims as amended now clarify that a substantial amount of ammonia-related family of contaminants as previously disclosed in the dependent claims 3, 5, and 27 are directed to rejects instead of permeates. Other dependent claims have been amended for formalistic issues.

By this Amendment, the Applicants have amended several claims to overcome the Examiner's rejections and respectfully makes assertions for overcoming the rejections of the outstanding Office Action dated May 24, 2006 in the following paragraphs.

#### **I. Claim Rejections- 35 U.S.C. §102(b)**

##### **A. U.S. Patent No. 4,574,049 to Pittner**

Claims 1, 2, 6-24 and 28, including the independent claims 1, 19, and 24 have been rejected as anticipated by U.S. Patent No. 4,574,049 to Pittner (the "Pittner '049" reference, hereinafter). The prior art as a whole including the Pittner '049 reference neither teaches nor suggests the present invention as claimed. The Pittner '049 reference discloses a chemical reverse osmosis water purification system and process in which the inlet of a second reverse osmosis unit is coupled in series to the product water outlet of a first reverse osmosis unit. Water to be

purified is conditioned by an ion exchange resin type water softener and pumped to the inlet of the first reverse osmosis unit. The product from the first reverse osmosis unit is treated with a chemical treatment agent, such as a sodium hydroxide solution, upstream of the inlet to the second reverse osmosis unit. The brine from the brine outlet of the second reverse osmosis unit is recirculated to the water flow line upstream of the first reverse osmosis unit.

**1. The Pittner '049 Reference is a Pure Water Purifier**

It is Applicants' position that the independent claims 1, 19, 24 and 29 as amended are not anticipated by the Pittner '049 reference. The Pittner '049 reference discloses a pure water purification system. In contrast, the present invention as claimed is utilized in an industrial setting where many contaminants such as hydrocarbon or ammonia are prevailing in high levels. The usage of reverse osmosis is old and goes back to the biblical times. However, the usage of the reverse osmosis in a hydrocarbon rich environment as presented in the present invention is new and thus deserves a patent.

The Pittner ' 049 reference discloses a water purification system that can only be used to purify a water feed with low contaminants. If the Pittner ' 049 reference were to be used in a hydrocarbon rich environment, the system will break within a week. There are numerous cases in the reference itself which undoubtedly proves that the Pittner ' 049 reference describes a system that can only be used in an environment such as a municipal drinking water plant. Specifically, the Pittner '049 reference discloses the follow facts about its invention:

*"In the majority of raw water supplies, calcium and alkalinity levels are sufficiently high that direct treatment by reverse osmosis would cause precipitation of calcium carbonate on membrane surfaces, reducing*

*productivity.*" Column 1, Line 26.

The "hardness in raw water" as stated by the Pittner ' 049 reference has sufficient levels of calcium and alkalinity that when concentrated in the membrane process, it could form carbon carbonate scale. There are additional places in the Pittner '049 reference which show the environment that Pittner had in mind, such as follows:

*"...which is used to pump, through the system, feed water from a municipal water supply or the like."* Column 2, Line 61.

*"A water purification process for removing dissolved solids of the type that are normally present in a municipal water supply or the like."*  
Column 6, Line 31.

*"A water purification process for removing dissolved solids of the type that are normally present in a municipal water supply or the like,"*  
Column 8, Line 4.

*" A water purification process for removing dissolved solids of the type that are normally present in a municipal water supply or the like"*  
Column 19, Line 12.

Thus, the reference describes that the "municipal water supply or the like" depending on one's local geology and catchment areas, the hardness in municipal waters typically range from 40 to 300 ppm. The description of the reference, with the variety of pretreatment options to avoid the calcium carbonate scale will be tailored depending on the precise makeup of the inlet water.

As mentioned above, this is in contrast to the contaminants tested in the industrial setting as claimed.

## **2. Applicants' Invention is Directed Toward a Different Environment**

In contrast, Applicants of the present invention investigated utilizing membranes readily available in the marketplace within last 6 or 7 years such as the S-series thin-film composite membrane from GE Osmonics, by varying pH levels in an industrial reverse osmosis system. In one experiment, Applicants investigated one of the most difficult to clean wastewater -- Sour Process Condensate. Such water composition comes from a refinery or a chemical process. In such water composition, there will be significant levels of H<sub>2</sub>S, ammonia, hydrocarbon, and dissolved organics present.

In essence, Applicants have stimulated the scenario by treating a feed water with an O&G (Oil And Grease ) and TOC (total organic carbon) from 200 ppm to 40,000 ppm. In contrast, in a surface water situation, the expected oil and grease will be zero and total organic carbon would be in the range of 1 to 5 ppm. The Applicants had surprisingly good results in the simple and efficient set-up environment. By varying the pH level, Applicants were able to utilize the reverse osmosis to reroute contaminants such as hydrocarbons and ammonia group to rejects. Such finding has incredible industrial usage and benefits and will lead to greater efficiency, better environment, and cheaper installations.

## **3. Ion Water Softner Proves a Non-industrial System**

The Pittner '049 reference discloses a system that requires an ionic water softener. This proves that the inlet is for a water with low contaminants. The hydrocarbon rich environment

would make such system unusable, because the oil would make the ion exchange and membrane clog up and stop functioning. In essence, the device according to the Pittner ' 049 reference discloses a membrane which is hydrophilic and not oleophilic like the current invention as claimed. There can be no exchange with oil. Specifically, the disclosure states:

*"In the illustrative embodiment, an ion exchange type water softener is provided upstream of the first of reverse osmosis unit for conditioning the water to be purified. The treating means referred to above comprises introducing a solution having a pH that exceeds 7, such as a sodium hydroxide solution." Column 2, line 10.*

The use of an ion exchange is a further evidence of the different types of water being treated. There is minimal hardness in the process condensate targeted according to the present invention as claimed. It is less than 5 ppm in many cases. Ion exchange resin is not oil and grease tolerant.

The hardness targeted by the ion exchange to prevent fouling from hardness scale (calcium and alkalinity) by Pittner ' 049 reference is present in the surface waters, where hardness can range from 10 to 400 ppm. The description in the reference, of the variety of options, may be tailored depending on the precise makeup of the inlet water.

#### **4. The Pittner '049 Device Can Not Be Reliable in an Industrial Environment**

The Pittner '049 reference states:

*"A further object of the present invention is to provide a water*

*purification system and process, using reverse osmosis techniques, **that is reliable** in operation and achieves high particle rejection"* column 1, line 50.

The Pittner ' 049 reference is directed to be reliable in operation, but will only be reliable in municipal/surface water application. It will not be oil and grease or total organic carbon tolerant.

**5. Use of a Carbon Filter is Appropriate When the Organic Loading is Low**

The Pittner '049 reference also states as follows:

*"In the illustrative embodiment, **a carbon filter is located upstream** of the water softener and a **5  $\mu$  cartridge filter** it is located now seen of the water softener and upstream of the pumping means. The brine outlet of the second reverse osmosis unit is coupled to the water flow line upstream of the first reverse osmosis."* Column 2, line 18.

The use of a common filter is appropriate when the organic loading is low. It is applicable if there is some color bodies in the surface water, again, low levels of organics.

The use of carbon filter in a water stream with a measurable oil and grease content will be exhausted in a matter of hours/days and is normally regenerated off site. This contradicts the theme of reliable operation.

**6. The Usage of a Cartridge Filter is Appropriate for the Surface Water**

The Pittner '049 reference also states:

*"A 5 micron cartridge filter 32 is provided to reduce the level of suspended solids in the water to the reverse osmosis membranes, the alleviating the possibility that 15 following by suspended solids will cause erroneous readings in performance."* Column 3, line 17.

The use of cartridge character is appropriate for the surface water treatment, where the normal suspended solids loading is again, relatively low in comparison to process condensate.

In the present invention is claimed, the configuration preferably uses the oil tolerant UF membrane that rejects the suspended solids in a continuous rejects stream as opposed to trapping the solids in a cartridge and then having to deal with the waste of a cartridge. In a typical US refinery environment, a cartridge change out costs \$3000-\$4000 per change. To filter a typical process condensate through a 5-micron filter would generate changes every few days, making the operation not only cost prohibitive, but inefficient. This is why the present invention as claimed do not advocate this technology in our usage.

#### **7. The Usage of Film-Tech BW30-4040 Module and Its Limitations**

Further, the Pittner '049 reference specifies:

*"Although no limitation is intended, reverse osmosis units 50 comprises two Film --Tec BW 30 -- 4040 reverse osmosis modules. Likewise, reverse osmosis unit 52 comprises two Film--Tech BW30--4040*



modules" column 3, line 17.

Film--Tec BW30--4040 membrane is a brackish water thin film composite polyamide membrane. Limitations are low TOC and temperature (less than 113 Fahrenheit, 45 °C).

Process condensate are typically 75°C to 85°C and is able to be handled by the modern membranes such as the GE Osmonics Duratherm membranes (formerly branded as the S series. The present invention as claimed in claim 32 notes that the present invention can handle temperature range between 60°F to 185°F (15°C. To 85 °C).

**8. The Organic Compound of Pittner ' 049 reference is Water Solvable Organics**

The Pittner '049 reference further states:

*"Similarly, organic molecules that are known to the present and difficult to remove from water supplies include a large variety of carboxylic acids. Carboxylic acids will ionize at various pH levels, all above 5, but an increasing percentage of them will ionize as the pH is increased."* Column 3, line 49.

This is evidence that the organic compound that the Pittner ' 049 reference discusses, is water solvable organics such as the carboxylic acids. In contrast, the hydrocarbon is present in a much higher oil and gas level and total organic, carbon level in the feed stream of the present invention as claimed.

**9. The Pittner '049 Reference Requires Setting Two Stage pH Levels**

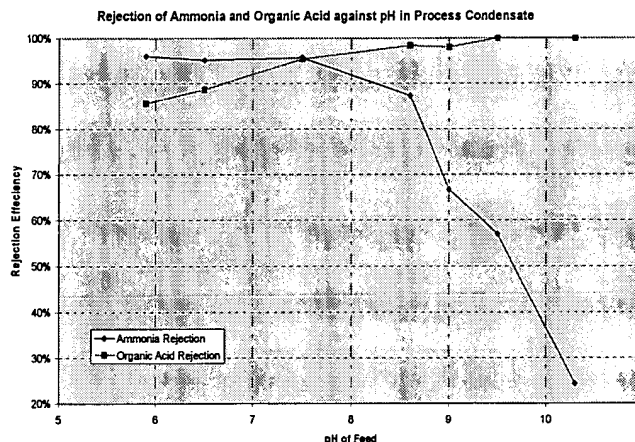
*"I have discovered that if the system is used for removal of organic impurities of water, and if these organic are of a mixed variety containing both basic and acidic types, it is preferred that the pH before the first stage be adjusted to below about 5, prefer below 4, and the pH before the second stage be adjusted to above 9" column 5, line 45.*

The present invention as claimed does not require this as the device as claimed and the method as claimed provides for good rejection of the organic acids at moderate pH levels and, if required, then the device or the method may drop the pH level to below 8 for optimal ammonia rejection.

**10. The Pittner '049 Reference Requires pH as low as 5**

"A process as described in claim 1, including the step of treating the water to be purified upstream of said reverse osmosis unit to adjust its pH to below about 5" column 7, line 4.

The present invention as claimed does not require the pH level to drop as low as 5 in processing the feed water. Applicants provide her with a graph overleaf showing the acceptable level of pH in achieving the rejection efficiency required.



Therefore, it is Applicants position that the Pittner '049 reference fails to disclose or suggest the present invention as claimed.

**B. U.S. Patent No. 5,925,255 to Mukhopadhyay**

Claims 1, 2, 6-10, 12-22 and 24-29 have been rejected by the U.S. Patent No. 5,925,255 to Mukhopadhyay (the "Mukhopadhyay '255" reference, hereinafter). It is Applicants' position that the prior art as a whole including the Mukhopadhyay '255 reference neither teaches nor suggests the present invention as claimed. The Mukhopadhyay '255 reference discloses a process for treatment of water via membrane separation equipment. According to the Mukhopadhyay '255 reference, hardness and non-hydroxide alkalinity are removed from feedwaters to very low levels, preferably by simultaneous removal in a weak acid action ion exchange resin. Then, ionization of sparingly ionizable components in the feedwater is substantially accomplished by

increasing the pH of the feedwater preferably up to about pH 10.5, or higher. In this manner, species such as silica become highly ionized, and (a) their rejection by the membrane separation process is significantly increased, and (b) their solubility in the reject stream from the membrane process is significantly increased.

**1. The Mukhopadhyay '255 Reference Requires Pretreatment Units**

The Mukhopadhyay '255 reference, which also refers to the Pittner '049 reference, is an improvement to the Pittner '049 reference, and suffers from the same deficiency as does the Pittner '049 reference.

That is, the Mukhopadhyay '255 reference discloses a complex system that includes a pretreatment process for removing a solute. Specifically, the solute treatment includes a treatment for removing hardness and substantially all alkalinity associated with the hardness. Such removal is performed in a different unit altogether. Thus, the system as disclosed in the Mukhopadhyay '255 reference fails to disclose the simple and efficient set up described by the Applicants above in Section IA3.

Further, the evidence that the Mukhopadhyay '255 reference requires a water softener similar to the Pittner '049 reference above, proves that the inlet is for a water with low contaminants. The hydrocarbon rich environment would make such system unusable, because the oil would make the ion exchange and membrane clog up and stop functioning.

There may be minimal hardness in the process condensate targeted according to the present invention as claimed. It is typically less than 5 ppm.

## **2. The Mukhopadhyay '255 Reference Does Not Remove Ammonia**

Finally, the Mukhopadhyay '255 reference neither discloses or suggests a system for removal of ammonia or amines family of contaminants. This can be seen clearly as none of the tables in the Mukhopadhyay '255 reference disclose either ammonia or amines as the type of contaminants targeted by the method disclosed in the Mukhopadhyay '255 reference. Therefore, the reasoning for taking the position that the Pittner '049 reference does not anticipate nor suggest the present invention as claimed, applies mutatis mutandis to the Mukhopadhyay '255 reference as well. Therefore, Applicants respectfully submit that the current amendments obviate this grounds of rejection and reconsideration and withdrawal are respectfully requested.

## **C. U.S. Patent No. 6,054,050 to Dyke**

Claims 1-7, 10-14, 19 and 20 have been rejected by the U.S. Patent No. 6,054,050 to Dyke (the "Dyke '050" reference, hereinafter). Unlike the other references cited above, the Dyke '050 reference does disclose a filtration system for ammonia and amines that is in an industrial setting. However, it is Applicants' position that the Dyke '050 reference does not anticipate nor does it suggest the present invention as claimed either. The Dyke '050 reference discloses a process for removing soluble and insoluble organic and inorganic contaminants from refinery wastewater streams employing ultra-filtration and reverse osmosis.

### **1. The Dyke '050 Reference Requires Pretreatment Units**

Similar to the Mukhopadhyay '255 reference, the Dyke '050 reference discloses a process that requires additional pretreatment system. Specifically, the system according to the Dyke '050

reference requires at least an ultra-filtration membrane to remove the insoluble contaminants and divalent and trivalent metal cations. Such complex system does not anticipate nor does it suggest the eloquent simplicity of the present invention as disclosed.

## **2. The Dyke '050 Reference Does Not Remove Ammonia Liquid.**

In addition, the method discloses that:

*"...**ammonia** present in the reverse osmosis permeate 32 can exist as ammonia gas. The hydrocarbons and ammonia gas can be easily stripped from the reverse osmosis permeate 32 by, for example, **nitrogen** or **steam**." (Col. 5, Ll. 63-67).*

Thus, it is clear that the method according to the present invention differs from the method of the Dyke '050 reference at least in three different ways. First, the method of the Dyke '050 reference discloses that the ammonia-type family is still present in the reverse permeate 32 in the reverse osmosis feedwater 28 as follows:

*"The concentration of non-ionized, soluble organic and inorganic contaminants still present in the reverse osmosis permeate 32 can vary widely, e.g., the concentration can range from about 5% in the case of xylene to about **100% in the case of ammonia** of the concentration in the reverse osmosis feedwater 28." (Col. 5, Ll. 14-20, Emphasis added).*

Further, the Dyke '050 reference does not disclose that the ammonia-type family is forcibly flow-regulated by pressure, i.e., the contaminants are in liquid form as in the present invention. Instead, the Dyke '050 reference discloses that the ammonia-type is in gaseous form as follows:

*"Since the pH adjusted reverse osmosis feedwater 28 passing through the reverse osmosis membrane 30 is at a high pH level, i.e., greater than 10.0, the ammonia present in the reverse osmosis permeate 32 can exist as **ammonia gas**. The hydrocarbons and **ammonia gas** can be easily stripped from the reverse osmosis permeate 32 by, for example, nitrogen or steam."* (Col. 5, Ll. 61-67, Emphasis added).

Finally, and most importantly, to remove the ammonia still present in the permeate, the ammonia removal of the Dyke '050 reference requires an evaporator distillate 38 as follows:

*"Optionally, the reverse osmosis permeate 32 can be combined with **evaporator distillate 38** together with the crystallizer water 44 and passed through a hydrocarbon recovery unit (HRU) 48 to remove any hydrocarbons, e.g., the low molecular weight soluble organic contaminants, and ammonia still present in the three streams to provide a recovered refinery wastewater stream 50."* (Col. 5, Ll. 55-61, Emphasis added).

Having an evaporator would increase the cost of the invention process to an extent that the benefit derived from the present invention would be minimal. Thus, the Dyke '050 reference neither anticipates nor suggests the present invention as claimed.

**Claim Rejections- 35 U.S.C. §103(a)**

Claim 23 has been rejected by Mukhopadhyay '255 reference in view of the Dyke '050 reference. Because none of the references above contain all of the elements, nor their equivalents, of the independent claim 19, claim 23 can not be made obvious by the combination

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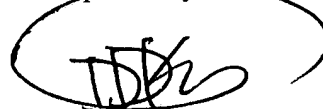
of the above references.

In view of the above amendments and remarks, Applicants respectfully submit that the present application, including claims 1-29 is now in condition for allowance. Favorable action thereon is respectfully requested.

Since this Amendment is in response to the Office Action dated May 24, 2006, Applicants requests that the Patent Office charge the deposit account of the Applicants' representative for one month extension of time and for four additional dependent claims. Also, if the Patent Office determines that additional fee is due, please charge any deficiencies or credit any overpayment in fees to deposit account no. 08-2461.

Should the Examiner have any questions with respect to the above amendments and remarks, the Examiner is respectfully requested to contact Applicants' undersigned counsel at the telephone number below.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'DK', is written over a horizontal line.

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